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OUR STATISTICS OF FOREIGN COMMERCE AND THE WAR.*

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It was a high commissioner of the British Government, visiting the States in 1917, who formulated the slogan that has been adopted by the statisticians and others using official trade statistics in war work in Washington. The distinguished foreign visitor had noted with deep interest the numerous somewhat contradictory announcements on the billboards, in the street cars, and in other advertising media to the effect that "ships will win the war," "food will win the war," "fuel will win the war," etc. His comment was that England had made the really vital discovery that statistics will win the war.

Just as it is a good thing that everybody in the Food Administration and people generally should appreciate the importance of food in winning the war, so is it of great moment that the statisticians should be intensely conscious, even excessively conscious, of the importance of statistics in winning the war. The statisticians in the statistical branches of war research in Washington were soon telling each other that "statistics will win the war." This idea permeated the ranks of all the economists and others in Washington using statistics, and was accepted by the compilers and clerks. The trained statisticians were not sufficient in number to do all the statistical work that was required in this process of winning the war by means of statistics. The universities were combed, and the leading business concerns were made subject to the draft for men to do statistical work. Economists and business executives were soon in the ranks in Washington doing statistical work. They soon adopted this slogan and in taking up any phase of their new

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line of work made it a point to start out with the statement that "statistics will win the war."

The catch phrase, which must be admitted as decidedly apt, does not particularly need apologists. Our war-time shipping program has come more and more to rest on a solid basis of tonnage statistics. Our export embargoes and even more our import embargoes have in part been based on calculation of tonnage that may be saved and diverted to more urgent traffic. We were slow in coming to the realization of the extent to which our shipping needs demanded that we change our organized industrial life—that we even give up entirely some customary raw materials for available or partly available substitute domestic raw materials. It was hard for our traders who had had their business connections exclusively with Java and India and other remote points to realize that they must henceforth draw their supplies of materials from Brazil or the West Indies, or other nearby points. It was something revolutionary in business. But it would save tonnage, and tonnage was necessary, and it was done; and put to it, the industries affected have found substitute commodities or substitute sources of supply and have managed to get along. Detailed statistical studies were the basis of this revolutionary change.

Similarly, if we had had detailed statistics of our inland commerce, we should not have felt the full severity of the shortage of freight cars at certain points and the congestion and subsequent embargoes. If we had known exactly the fuel requirements of New England and other great industrial, non-coal producing regions, the hardships of the winter of 1917–1918 could have been avoided. It is only very recently that the Department of Commerce, by statistical studies, has made known to the nation the tremendous increase in carrying efficiency that can be accomplished by a comparatively slight outlay on the Delaware and Chesapeake Canal, the Raritan Canal, and the Cape Cod Canal. It seems almost incredible, yet it is undoubted that at an expenditure on the Delaware and Chesapeake Canal of something like $12,000,000 for work in a very favorable terrain with practically no obstacles, the

distance from Baltimore north and from Baltimore to Europe for heavy ocean traffic can be shortened 184 miles.

These are things which we now appreciate and the nation owes a debt of gratitude to these able statisticians and economists and business men who have driven these things home and put through, without hesitation, a program that has enabled us to take advantage of things which we ought to have known before but did not. "Statistics will win the war" is truly not hard to justify.

Trade statistics of the United States are in the main represented by the monthly publication, *Monthly Summary of Foreign Commerce*, and the annual publication, *Commerce and Navigation of the United States*. Our statistical classification of imports, probably more because of tradition than necessity or legal requirement, has pretty closely followed the United States customs tariff. The statistical classification of exports has been a growth of many years, on a somewhat anomalous basis of grouping and alphabetical arrangement. The statistical schedules have been further refined from year to year. There is a constant demand on the part of commercial interests, for refinement of classifications, so that the number and scope of the "All other, not specially provided for" classifications will be cut down. There has been no change in the system of statistical classification; change has been only in this matter of detail, with a tendency toward more specialization.

Next year before this association I expect the story can be told how the export and import classifications have been given a thorough overhauling, arranged on a scientific group basis, with more emphasis on quantity figures, and harmonized somewhat with other statistical classifications. There will also undoubtedly be a story to tell about the change from fiscal year to calendar year, and the change to a country grouping which is more in keeping with the known facts and accepted standards of commercial geography. Within the Bureau of Foreign and Domestic Commerce we have broken ground for all these changes, with the stimulus and very able assistance of some of the country's leading statisticians and commercial geographers,

doing war work on the staffs of the Shipping Board, War Trade Board, and War Industries Board.

Our export and import statistics, probably more than any other official statistics collected by the United States Government, are, even in normal times, in demand for government uses. They are for the guidance of Congress in preparing fiscal legislation and legislation bearing on international commercial relations. They are for the use of the Treasury Department and the Department of Commerce in carrying out their administrative functions in connection with the administration of the customs tariff, the navigation laws, etc. They are for the guidance of the Department of State and the Department of Commerce in working out international commercial programs. They are essential to the United States Tariff Commission. The Department of Agriculture and the Department of the Interior use them in determining the direction and effect of the promotive work entrusted to these departments in connection with the development of the natural resources of the United States. And of course, in war time the foreign trade statistics are an indispensable basis for the determination of policies and effects of the administration of the various war-time activities entrusted to such organizations as the War Trade Board, United States Shipping Board, the War Industries Board, the Food Administration, and the Fuel Administration.

There are two other classes of persons who are interested in the official trade statistics of our exports, imports, and tonnage: the business men, and the academic economists, statisticians and writers. The business man who uses the trade statistics is apt to go on the basis that the government collects trade statistics primarily for his benefit. The economists and statisticians are apt to assume that the government collects trade statistics in order to make possible the careful analysis of the progress of the country, to enable the student today to reconstruct the past or the student tomorrow to reconstruct the period in which we now live. Some overlook the fact that the government started collecting statistics of exports, imports and tonnage primarily for fiscal reasons, for the guidance of Congress and the ad-

ministrative branches of the government and that to this day that is probably the most important end which the statistics have served.

Trade statistics with us from the beginning have been on a utilitarian basis. In Germany where there has been more of the cult of statistics for the sake of statistics and statistics for the statisticians, this utilitarian standpoint has been somewhat obscured. During the war the printed discussions of some of the leading statisticians of Germany have opened up the old German moot questions of statistics to enable the historian, economist, and sociologist of a hundred years hence to reconstruct a precise picture of the furious age in which we are living. In the United States the statistics have been put to greatly increased use during the war, but with more workaday promptings.

In recent years in the United States our official trade statistics have come more and more to be used by our business men as a basis for their operations. I was told recently by an international operator in one of our most important bulk imports of raw materials, that his business month for month for a period of years has been based on the statistics published by our Department of Commerce, and that he has attributed his financial success to his statistical familiarity with the state of his market. The largest manufacturer of an important line of metal goods in the United States, who has for years carried on a nation-wide business, recently told me that his sales program and his advertising appropriations are blocked out unit for unit on the basis of the population statistics issued by our Bureau of the Census. He has recently gone extensively into the export trade, and has been making an effort to arrange his sales campaigns in foreign markets on a statistical basis—very hard to do, but possible. Today the American manufacturer and merchant makes his plans more and more in the light of trade statistics. In the Bureau of Foreign and Domestic Commerce in Washington there is an opportunity to watch this development and to see the increasing use of the trade statistics for dollars and cents purposes. This is true of the trade statistics of foreign countries as well as of trade statistics of the United

States. The whole movement in this direction has been quickened by indispensable wartime reference to trade statistics.

The *Monthly Summary* and the annual volume of *Commerce and Navigation*, supplemented since 1913 by the handy little manuals on "Trade of the United States with the World," taking up exports and imports, by countries, article by article, have well served the main demand for statistical information from the three groups that have been mentioned. The detailed statistics in *Commerce and Navigation*, and the *Trade of the United States with the World*, have been of chief use to Congress and the government offices. The *Monthly Summary* and *Trade of the United States with the World* have served the chief needs of the business men. The economists, statisticians and writers have of course required all the published statistics. The Chief of the Bureau of Foreign and Domestic Commerce makes annually a brief text review of the figures; the war brought out the need of further analysis, and the Department will henceforth publish more analytical comment.

In addition to the published statistics the Department of Commerce has at all times had to meet a demand for special compilations. The Ways and Means Committee of Congress has possibly been the best customer and the most severe taskmaster of the Department in this regard. The committee makes constant use of the official trade statistics, and requires detailed statistical analyses and combinations that could not be anticipated or provided for by general publication. These compilations have to be made specially, and the Department of Commerce has to meet this demand. Similarly the published statistics do not serve all the purposes required by the business men, and special compilation is required to serve business needs. The Bureau of Foreign and Domestic Commerce does such special compilation with reference to a number of the exports and imports of principal importance in American business. In addition many of the trade associations and trade papers have assigned special representatives who make these specialized compilations from the material available in the Bureau. The new problems of war trade and after-war trade have increased the demand for special compilations.

At the outbreak of the world war when we were cut off from trade with Germany we were probably more inconvenienced by the threatened lack of dyestuffs and chemicals than by any other one thing. The dyestuff industry of the United States was on a small scale. We had to have dyestuffs, and there was an opportunity for creating an American dyestuffs industry. The published statistics of the United States did not furnish any clue as to the quantities of individual dyestuffs required for the American market. There was nothing to guide the old and prospective dyestuff manufacturers as to the dyestuffs that were needed here. The nature of the individual dyestuffs was concealed by "All other, not specially provided for" clauses. Estimates, even by the men most intimately associated with the trade, were widely at variance.

The question arose how a statistical basis for the establishment of an American dyestuff industry could be reached. It was decided that the only way was to dig out the invoices of every shipment that had come into the United States in the year 1913, as a pre-war year, and copy the facts off the consular invoices. This was actually done—regarded then as a staggering job. The work was under the supervision of an eminent chemist and statistician who had a technical familiarity with the subject, and personal familiarity with the German dyestuff industry, and recognized standing as a writer on the subject. This statistical census of dyestuff imports has been an important factor in the establishment of the American dyestuff industry, which is already of such proportions as to amaze any one familiar with its status before the war.

The success of the dyestuff census brought a demand for the continuation of the study to all other chemicals. In order that our Department of Agriculture and Geological Survey and our chemical manufacturers and producers in this country may know what the American market requires, the Bureau of Foreign and Domestic Commerce has had a staff, at times as many as thirty employees, tabulating the statistical data in the greatest possible detail from 1913 invoices of imports of all kinds of chemicals other than dyestuffs. This was a task for a chemist as well as a statistician, and

although the results have not yet been published the work has proceeded on sound statistical lines as well as on a sound technical foundation. This is commercial statistical work of a practical nature for the national benefit of industry, which I doubt if any foreign country has ever equalled.

When the United States entered the war a heavy demand for statistical information was made on the Bureau of Foreign and Domestic Commerce, and that demand on the whole has increased rather than diminished. The main call for information has been from the government offices. Trade statistics became of moment to the War Department and the Navy Department. They were the backbone of the work of the War Trade Board, the Shipping Board, and most essential for the work of the Food Administration, the War Industries Board, the Fuel Administration, and other government offices. It became necessary to analyse trade channels, trade regions, the tonnage movements between the United States and foreign countries, the trade in individual commodities, and the trade of individual ports, and the trade as a seasonal phenomenon. It became necessary to go back over the trade for a number of years, to make compilations by months, by ports, by countries, and by commodities, that had never been made before. It became necessary to have current reports on the trade at shorter intervals than the customary period of one month, and to speed up the transmission of returns from all the customhouses, speed up the work of compilation, and speed up the final transmission of the statistical data to the war boards in Washington. The Bureau of Foreign and Domestic Commerce and the Treasury officials for a time wrestled with these problems without new means of carrying them to perfection. Some of the war-time organizations were being delayed and interfered with in their work, although I believe practically every one who had the opportunity for calm judgment as to the way the Treasury and Commerce Departments were proceeding with their available resources gave them credit for what they were accomplishing.

It was in midwinter, 1917–1918, when the true realization of the importance of a statistical basis for the export and import embargoes and tonnage conservation was first arrived at.

It was at that time that the difficulties under the old normal scheme of getting statistical returns came to a head. There were committee meetings in Washington at which the war boards told what their needs were. The Treasury Department and the Department of Commerce were freely criticised. Some of the enthusiastic statisticians in the war boards were for taking over *in toto* the work of compiling the trade statistics, and making it a war matter. These statisticians were overlooking the legal basis and *raison d'ëtre* for the publication of the statistics—were overlooking the demands of Congress, the demands of the business men, and the most intimate connection of the trade statistical work, as an integral part, with the whole mechanism of trade information of the Department of Commerce.

Cooler judgment finally prevailed in the meetings of the committees, the requirements of the war boards were definitely formulated, and the Treasury Department and the Department of Commerce pledged themselves to do everything possible to meet these demands. The war boards coöperated in a request to the President for an emergency appropriation for additional clerical and other assistance and the work was soon under way. The chief demand of the war boards was that they should receive statistical returns of trade for ten-day periods, instead of periods of one month. The returns have been made on that basis, I think to the satisfaction of the Shipping Board and the War Trade Board and the Food Administration, the offices chiefly concerned. These various boards of course required their own statistical divisions to work up the basic materials into the combinations which were required for their special purposes. The War Trade Board got together a very large statistical organization for tabulating export license returns and making the comparison between license returns and export figures. The ten-day reports placed a strain on the customs service, and credit is due to the customs organization for the untiring efforts and intelligent direction of machine tabulation and other helps to rapid compliance with the requests of the war boards. The ten-day reports have been kept confidential and no publicity is given to the returns on that short-time basis.

I have referred to the intimate connection of the official trade statistics with the trade information work of the Bureau of Foreign and Domestic Commerce. The effects of war restrictions have brought about an unprecedented interest in foreign trade statistics on the part of our manufacturers. The demands for statistical information have been steadily increasing. As an import embargo has been placed on a certain commodity, or as ship space to a certain foreign market has become progressively restricted, the manufacturers have been forced to take an interest in possible substitute materials and possible substitute markets. The Bureau of Foreign and Domestic Commerce is called on to advise the manufacturers on all these points, and the Bureau is also required to supply in this connection foreign trade information with reference to foreign countries that is sent in by commercial attachés, trade commissioners and special agents of the Department of Commerce, and consular officers.

There is another side to this question in addition to the export and import and tonnage statistics officially collected by the United States Government. The Bureau of Foreign and Domestic Commerce is probably the leading center in this country for statistical information, general economic information, and market reports, with reference to foreign countries. In 1909 the Bureau for the first and last time issued a statistical abstract for foreign countries. Since that year the Bureau has not had appropriations which would enable the continuance of that publication, but has none the less continued to do what work has been done by our government on the official statistics of trade of foreign countries. In addition to the statistics of imports and exports which are required by law at our customhouses in this country, we receive official reports of the values of merchandise for which consular invoices are executed by our consuls in foreign countries. These reports are published in *Commerce Reports* and in the special *Supplements to Commerce Reports,* and have always been of interest to close students of statistics of trade with particular sections of foreign countries. Although the Bureau of Foreign and Domestic Commerce has not been able to continue the statistical abstract of foreign countries it has con-

tinued a section on the statistics of the principal countries in the Statistical Abstract of the United States. That section, though very brief, has become a well-recognized source of ready reference material on the commercial and financial statistics of other countries. The official statistics of all foreign countries and colonies are currently received in the Bureau of Foreign and Domestic Commerce and are in constant use there.

Again, compilation in Washington of these statistics of foreign countries has been largely of an utilitarian nature. American manufacturers have wanted to know where given foreign countries purchased their supplies or disposed of their manufactured products, and have called on the Bureau for special statement work of this nature involving compilation from the statistics of foreign countries. The reports of the United States consuls, of commercial attaches, special agents, and trade commissioners on foreign countries have been amplified by a statistical analysis of the foreign markets which they cover. During the war, when minute surveys of the trade of foreign countries have been necessary, this class of work has been done on a larger scale than before.

The special statement work on foreign statistics of necessity had to be limited, as does the special statement work on statistics of the United States, and so far as compilations for commercial organization are concerned, the Bureau has coöperated by making the statistical publications available and supervising the work of outside compilers. Congress and most of the executive departments in Washington have for years looked to the Bureau of Foreign and Domestic Commerce as the center for statistical information on commercial matters of all kinds relating to foreign countries, as well as to the United States. There has been this demand for statistical analysis of certain questions to meet the wishes of the Ways and Means Committee and the other important committees of Congress having to do with commercial questions. Here again there was an unprecedented demand brought on by the war. The War Department and the Navy Department have been deeply interested in the statistics of sources of supply of raw materials of war importance, and facts

concerning the market conditions, accessibility, etc. With reference to all foreign countries such information was available in the Bureau of Foreign and Domestic Commerce and demands have been made on the Department to work up the material for the purposes indicated.. The staff of the Bureau was not sufficient to meet the increased demands by the war-time organizations, by Congress, and by the business men, so there has been further increase of staff.

The Latin-American Division of the Bureau of Foreign and Domestic Commerce probably has more information with reference to commercial matters in Latin-America than any other one office in the world. This information has been of untold value to the various war organizations. The Bureau has made statistical studies of the foreign trade of Germany and Austria-Hungary, country by country, and article by article. The Bureau has published statistics of the commerce of Germany and Russia, in connection with a study of the commercial treaty status of the two countries which have proved most illuminating. The Bureau has ecently published statistics with reference to the sources of supply and consumption of the principal industrial raw materials and foodstuffs, in connection with a summary report on tendencies in economic reconstruction. Statistical studies of the trade of the principal countries of the world by countries and articles are now under way in the Bureau, and will unquestionably prove of value in forthcoming studies of international relations, as well as providing an index for American manufacturers in sizing up foreign markets for their goods and foreign sources of supply for their raw material. These statistics of foreign countries are chiefly being utilized for these basic purposes, although certain specific trade studies,—such as the study of the exports of cotton goods from every producing country and the imports of cotton goods in every consuming country,—are being made. If it is important that Congress and our treaty makers should know the courses of trade, it is none the less important that our merchants and manufacturers should have the information available

There is one other aspect of the statistical work of the Bureau of Foreign and Domestic Commerce which has only incident-

ally been touched—I refer to the Statistical Abstract of the United States. The Statistical Abstract of the United States is in the main made up of statistics of trade and industry. The biggest single contribution to the subject matter is the statistics of imports and exports of the United States and the carrying trade of the United States. There is a good deal of other statistical matter included bearing on commerce which is kept currently up to date in the Bureau of Foreign and Domestic Commerce although original compilation is done by trade organizations, or commercial companies, trade papers, or other unofficial sources. The statistical record of progress of the United States from 1800 to date published in the *Statistical Abstract* is kept up currently by the Bureau of Foreign and Domestic Commerce. To meet wartime requests this section and the foreign-country tables have been brought up to the latest date possible and issued separately. Probably the *Statistical Abstract* more than any other one publication has made the Bureau known as a central information office on all phases of commercial and industrial statistics. The *Abstract* answers a multitude of inquiries, and relieves the other government offices of a considerable volume of correspondence. Of course the Bureau of Foreign and Domestic Commerce makes no effort to answer inquiries that should properly be handled by the Bureau of the Census or the Postmaster-General, or the Bureau of Mines, and the other government offices. The *Statistical Abstract* does contain much of the trade information which has been required by the war-time organizations and business men since the outbreak of the war, but with the exception of the information with reference to the effects and results of the first selective draft, the *Abstract* itself shows little change as a result of the war.

I am not a technical statistician, and am not primarily interested in the theory of statistics or in the highly technical aspects of methods of statistical presentation. As a trade investigator and writer on commercial subjects and as a minor official of the federal government I have used trade statistics many years. Recently I have had administrative oversight of the work of compilation of the trade statistics of the United States. The whole work of the Bureau of Foreign and Domestic Com-

merce is built up around the statistical work. It is my opinion, based on my experience in that work, that the Bureau of Foreign and Domestic Commerce would lose vastly in its efficiency if it did not handle the actual compilation of the trade statistics of the United States. The conclusions reached by some of the committees of administrative officers and statisticians have been that this subject of trade statistics of the United States is simply one phase of trade information and that it should be regarded as such and entrusted to the office which is given by law the position of central information office for trade information, that is the Bureau of Foreign and Domestic Commerce. So long as our statistics are to be regarded from a practical standpoint, I feel that there is the best of reason for having actual compilation done by the offices that are primarily concerned with the subject matter. As the Bureau of Mines and the Geological Survey and the Department of Agriculture would suffer in efficiency by the transfer of their statistical work away from them to a central bureau of statistics, so would the Bureau of Foreign and Domestic Commerce suffer from the transfer of the trade statistics to any such central bureau. The question of a central bureau of statistics has been urged time and again, and was brought up in Washington acutely in connection with the war demands. Since September 1 of this year there has existed a Central Bureau of Planning and Statistics, but, I think fortunately, that Bureau has been organized with the recognition of the value of compilation in the offices primarily concerned with the subject matter, and has acted simply as a clearing house for information and means of eliminating duplication.

The war has placed a very severe test on the efficiency of our official mechanism of tabulating and compiling statistics, both of the United States and of foreign countries. We have had a great amount of ground to cover, and undoubtedly we have not covered it so well as it would have been possible to cover it, with unlimited funds and resources and perfected organization. To meet the strain of war requirements radical changes have been necessary; many of the formerly accepted traditions of official trade statistics have been abandoned; the

impetus and enthusiasm, the war needs, and the greatly increased use of official statistics by statisticians, economists, government officials, and business men, have all contributed to progress in methods, and improvement in performance which would have been slow in forcing their way through if the old routine had not been upset by war. On the whole, however, I feel that there is no need for apology on the part of any of the government offices concerned.

EFFECT OF GROUPING IN GRADUATION BY OSCULATORY INTERPOLATION.

By Percy C. H. Papps.

The problem of ascertaining the rate of mortality amongst the general population is quite different from that of ascertaining the rate amongst a selected body of lives. In ascertaining the rate of mortality amongst the members of an insurance company, fraternal society, etc., it is possible to ascertain the number exposed to the risk of death at each age and the resulting deaths. Where it is desired to ascertain the rates of mortality at different ages amongst the population in the registration states, for example, it is necessary to compare as closely as possible the numbers living at each age with the resulting deaths, as in the case of a selected body of lives; but this can only be done by taking the population as shown by the census returns, made once in ten years, and comparing the numbers living at each age with the deaths at each age, as ascertained from the records of deaths, which are preferably taken from the records for a few years before and after the census.

To overcome the irregularities resulting from the data not being sufficiently extensive to give average results and to overcome errors arising in the collection and compilation of the data, graduation is necessary. In computing the rate of mortality amongst a select body of lives, an ungraduated life table may first be compiled from the ungraduated rates of mortality, and a graduated table obtained therefrom. In handling population statistics it is usual to graduate both the population and the deaths, and then to derive what is a graduated rate by dividing the graduated deaths by the graduated population statistics. It must be remembered that in handling population statistics much more extensive errors in the collection of the data have to be handled than where the rates of mortality are to be determined from the record of an insurance company or a fraternal society.

In the June 1910 Quarterly Publications of the Ameri-

can Statistical Association, pages 86 to 109, will be found an account of the graduation of the data derived from the twelfth census of the registration states by Professor Glover. The graduation is made by Osculatory Interpolation and the table on page 100 shows that the well recognized errors due to the tendency to overstate the population at the quinquennial ages ending in 0 and 5 are distributed in each case over the succeeding four ages. For example, the sums of the graduated and ungraduated population for ages 35 to 39 inclusive are identical so that the overstatement of the population at age 35 is spread over ages 36 to 39.

It is proposed to write the graduated values in terms of the ungraduated values for the formula actually used as well as for four similar formulae derived from grouping ages ending in 1 to 5, 2 to 6, 3 to 7 and 4 to 8.

The graduation is made by first summing the numbers in the column showing the population from the bottom up, and then operating on this summation column which gives the population at each age and all higher ages. The deaths were graduated in a similar manner.

Now, let u_x, u_{x+1}, u_{x+2}, etc., be terms of the original series,

$$U_x = \Sigma_x^\omega u_x$$
$$\Delta U_x = U_{x+5} - U_x$$

and

$$\delta U_x = U_{x+1} - U_x = -u_x$$

Then, writing the leading quinquennial differences of U_x in terms of the original series, the results shown in the following table are arrived at, where the coefficients are shown in the columns and the expressions to which they apply in the headings of the columns.

TABLE A.

	$\Sigma_{x+20}^{x+24} u_x$	$\Sigma_{x+15}^{x+19} u_x$	$\Sigma_{x+10}^{x+14} u_x$	$\Sigma_{x+5}^{x+9} u_x$	$\Sigma_{x}^{x+4} u_x$
ΔU_x					−1
$\Delta^2 U_x$				−1	+1
$\Delta^3 U_x$			−1	+2	−1
$\Delta^4 U_x$		−1	+3	−3	+1
$\Delta^5 U_x$	−1	+4	−6	+4	−1

On page 93 Professor Glover gives a table showing the coefficients of the expressions for the subdivided differences in terms of the differences for intervals of five ages. The table in terms of the present notation is as follows:

TABLE B.

	ΔU_{x-10}	$\Delta^2 U_{x-10}$	$\Delta^3 U_{x-10}$	$\Delta^4 U_{x-10}$	$\Delta^5 U_{x-10}$
δU_x	+.2	+.32	+.088	−.0176	+.0016
$\delta^2 U_x$		+.04	+.048	+.0016	+.0048
$\delta^3 U_x$			+.008	+.0064	−.0048
$\delta^4 U_x$				+.0016	−.0032
$\delta^5 U_x$					+.0080

By means of Tables A and B the leading yearly differences of U_x may be computed in terms of the original series. The results are shown in Table C.

TABLE C.

	$\Sigma_{x+10}^{x+14} u_x$	$\Sigma_{x+5}^{x+9} u_x$	$\Sigma_{x}^{x+4} u_x$	$\Sigma_{x-5}^{x-1} u_x$	$\Sigma_{x-10}^{x-6} u_x$
δU_x	−.0016	+.0240	−.1504	−.0843	+.0128
$\delta^2 U_x$	−.0048	+.0176	−.0720	+.0704	−.0112
$\delta^3 U_x$	+.0048	−.0256	+.0400	−.0224	+.0032
$\delta^4 U_x$	+.0032	−.0144	+.0240	−.0176	+.0048
$\delta^5 U_x$	−.0080	+.0320	−.0480	+.0320	−.0080

The first line in Table C gives one formula for ascertaining a graduated value of u_x, for $u_x = -\delta U_x$ and by writing δU_{x+1}, δU_{x+2}, etc., in terms of the differences shown in Table C, four other formulae may be found. By the usual formula the values in Table D are found.

TABLE D.

	δU_x	$\delta^2 U_x$	$\delta^3 U_x$	$\delta^4 U_x$	$\delta^5 U_x$
δU_x	+1				
δU_{x+1}	+1	+1			
δU_{x+2}	+1	+2	+1		
δU_{x+3}	+1	+3	+3	+1	
δU_{x+4}	+1	+4	+6	+4	+1

By means of Tables C and D the following formulae are obtained, the one first derived in Table C being repeated.

TABLE E.

	$\Sigma_{x+10}^{x+14} u_x$	$\Sigma_{x+5}^{x+9} u_x$	$\Sigma_{x}^{x+4} u_x$	$\Sigma_{x-5}^{x-1} u_x$	$\Sigma_{x-10}^{x-6} u_x$
δU_x	−.0016	+.0240	−.1504	−.0848	+.0128
δU_{x+1}	−.0064	+.0416	−.2224	−.0144	+.0016
δU_{x+2}	−.0064	+.0336	−.2544	+.0336	−.0064
δU_{x+3}	+.0016	−.0144	−.2224	+.0416	−.0064
δU_{x+4}	+.0128	−.0848	−.1504	+.0240	−.0016

It will be noticed that the first and last and second and fourth formulae in Table E have similar coefficients but in reverse order. The coefficients in the third formula are symmetrical.

Now, any value such as δU_y may be derived as shown in the following table:

TABLE F.

δU_y Derived from	Age Groupings
δU_y	y to $y+4$, $y+5$ to $y+9$ etc.
δU_{y-1+1}	$y-1$ " $y+3$, $y+4$ " $y+8$ "
δU_{y-2+2}	$y-2$ " $y+2$, $y+3$ " $y+7$ "
δU_{y-3+3}	$y-3$ " $y+1$, $y+2$ " $y+6$ "
δU_{y-4+4}	$y-4$ " y, $y+1$ " $y+5$ "

It is interesting to notice that if one fifth of the sum of the five formulae shown in Table E be taken, we obtain the twenty-nine term Osculatory Interpolation formula given by Mr. George King on page 559 of Volume 41 of the Journal of the Institute of Actuaries. The method of arriving at this formula is shown in the following table, and the table gives a ready comparison of the different formulae in terms of the original series. In this table the different formulae run vertically instead of horizontally as in the previous tables.

TABLE G.

	δU_y	$\delta U_{\overline{y-1}+1}$	$\delta U_{\overline{y-2}+2}$	$\delta U_{\overline{y-3}+3}$	$\delta U_{\overline{y-4}+4}$	Total	1/5 Total
u_x-14					−.0016	−.0016	−.00032
u_x-13				−.0064	−.0016	−.0080	−.00160
u_x-12			−.0064	−.0064	−.0016	−.0144	−.00288
u_x-11		+.0016	−.0064	−.0064	−.0016	−.0128	−.00256
u_x-10	+.0128	+.0016	−.0064	−.0064	−.0016	0	0
u_x-9	+.0128	+.0016	−.0064	−.0064	+.0240	+.0256	+.00512
u_x-8	+.0128	+.0016	−.0064	+.0416	+.0240	+.0736	+.01472
u_x-7	+.0128	+.0016	+.0336	+.0416	+.0240	+.1136	+.02272
u_x-6	+.0128	−.0144	+.0336	+.0416	+.0240	+.0976	+.01952
u_x-5	−.0848	−.0144	+.0336	+.0416	+.0240	0	0
u_x-4	−.0848	−.0144	+.0336	+.0416	−.1504	−.1744	−.03488
u_x-3	−.0848	−.0144	+.0336	−.2224	−.1504	−.4384	−.08768
u_x-2	−.0848	−.0144	−.2544	−.2224	−.1504	−.7264	−.14528
u_x-1	−.0848	−.2224	−.2544	−.2224	−.1504	−.9344	−.18688
u_x	−.1504	−.2224	−.2544	−.2224	−.1504	−1.0000	−.20000
u_x+1	−.1504	−.2224	−.2544	−.2224	−.0848	−.9344	−.18688
u_x+2	−.1504	−.2224	−.2544	−.0144	−.0848	−.7264	−.14528
u_x+3	−.1504	−.2224	+.0336	−.0144	−.0848	−.4384	−.08768
u_x+4	−.1504	+.0416	+.0336	−.0144	−.0848	−.1744	−.03488
u_x+5	+.0240	+.0416	+.0336	−.0144	−.0848	0	0
u_x+6	+.0240	+.0416	+.0336	−.0144	+.0128	+.0976	+.01952
u_x+7	+.0240	+.0416	+.0336	+.0016	+.0128	+.1136	+.02272
u_x+8	+.0240	+.0416	−.0064	+.0016	+.0128	+.0736	+.01472
u_x+9	+.0240	−.0064	−.0064	+.0016	+.0128	+.0256	+.00512
u_x+10	−.0016	−.0064	−.0064	+.0016	+.0128	0	0
u_x+11	−.0016	−.0064	−.0064	+.0016		−.0128	−.00256
u_x+12	−.0016	−.0064	−.0064			−.0144	−.00288
u_x+13	−.0016	−.0064				−.0080	−.00160
u_x+14	−.0016					−.0016	−.00032

It will be noticed that the formulae in Table G give the values of δU_y or $-u_y$, so that to obtain the values of u_y or u_x the signs must be changed.

The first five formulae in Table G may be more readily applied if the column of U_x be first computed and the five formulae written in terms of U_x instead of u_x. In Table H the formulae are written in terms of U_x and the signs are changed so that u_x instead of $-u_x$ is obtained directly from the formulae.

TABLE H.

	δU_y	$\delta U_{\overline{y-1}+1}$	$\delta U_{\overline{y-2}+2}$	$\delta U_{\overline{y-3}+3}$	$\delta U_{\overline{y-4}+4}$
U_{x-14}					+.0016
U_{x-13}				+.0064	
U_{x-12}			+.0064		
U_{x-11}		−.0016			
U_{x-10}	−.0128				
U_{x-9}					−.0256
U_{x-8}				−.0480	
U_{x-7}			−.0400		
U_{x-6}		+.0160			
U_{x-5}	+.0976				
U_{x-4}					+.1744
U_{x-3}				+.2640	
U_{x-2}			+.2880		
U_{x-1}		+.2080			
U_x	+.0656				
U_{x+1}					−.0656
U_{x+2}				−.2080	
U_{x+3}			−.2880		
U_{x+4}		−.2640			
U_{x+5}	−.1744				
U_{x+6}					−.0976
U_{x+7}				−.0160	
U_{x+8}			+.0400		
U_{x+9}		+.0480			
U_{x+10}	+.0256				
U_{x+11}					+.0128
U_{x+12}				+.0016	
U_{x+13}			−.0064		
U_{x+14}		−.0064			
U_{x+15}	−.0016				

For the population the T_x column corresponds with the U_x of the above table. By setting the values of T_x on the multiplying machine and multiplying by the coefficients shown in Table H, without clearing the product holes, the graduated value of u_x, in this case L_x, are obtained directly; care being taken to see that the machine is set for multiplication when the coefficient is positive and for division when the coefficient is negative. If one of these short formulae is to be used, the graduated values can be more directly and rapidly obtained in this manner than by building up the differences and subdivided differences shown by Professor Glover.

In the following tables are shown graduated values of L_x, d_x and q_x according to the five formulae. The average of

these values is shown which corresponds to the values that might be obtained directly by Mr. King's twenty-nine term Osculatory Interpolation formula, which may be applied by the summation method. The values are shown for ages 30 to 40 inclusive. Tables I, J and K give the values of L_x, d_x and q_x; the latter derived from the formula used by Professor Glover, namely

$$q_x = \frac{d_x}{L_x + \frac{1}{2}d_x}$$

TABLE I—VALUES OF L_x.

x	x to $x+4$ $x+5$ " $x+9$	$x-1$ to $x+3$ $x+4$ " $x+8$	$x-2$ to $x+2$ $x+3$ " $x+7$	$x-3$ to $x+1$ $x+2$ " $x+6$	$x-4$ to x $x+1$ " $x+5$	Average Values
30	*173,618*	172,937	177,940	176,353	177,033	175,576
31	169,201	*169,372*	168,500	173,088	171,805	170,393
32	166,978	160,405	*165,600*	165,228	167,208	165,084
33	161,093	161,563	154,471	*162,809*	162,653	160,518
34	159,571	154,160	157,264	153,401	*160,559*	156,991
35	*157,926*	156,121	149,430	154,912	155,210	154,720
36	156,259	*155,128*	152,851	148,350	153,658	153,249
37	152,032	157,691	*151,846*	149,880	149,366	152,163
38	149,889	150,573	156,234	*147,839*	146,987	150,304
39	144,042	150,934	147,535	150,025	*143,313*	147,170
40	*138,832*	141,327	148,912	141,978	140,883	142,386

TABLE J—VALUES OF d_x.

x	x to $x+4$ $x+5$ " $x+9$	$x-1$ to $x+3$ $x+4$ " $x+8$	$x-2$ to $x+2$ $x+3$ " $x+7$	$x-3$ to $x+1$ $x+2$ " $x+6$	$x-4$ to x $x+1$ " $x+5$	Average Values
30	*1,445*	1,452	1,483	1,453	1,487	1,464
31	1,468	*1,436*	1,448	1,479	1,473	1,461
32	1,488	1,441	*1,437*	1,461	1,471	1,460
33	1,459	1,499	1,434	*1,455*	1,484	1,466
34	1,501	1,440	1,510	1,461	*1,484*	1,479
35	*1,509*	1,517	1,440	1,520	1,508	1,499
36	1,549	*1 534*	1,527	1,470	1,529	1,522
37	1,538	1,595	*1,548*	1,532	1,516	1,546
38	1,559	1,546	1,614	*1,546*	1,531	1,559
39	1,531	1,609	1,546	1,591	*1,533*	1,562
40	*1,522*	1,538	1,626	1,533	1,543	1,552

TABLE K—VALUES OF q_x.

x	x to $x+4$ $x+5$ " $x+9$	$x-1$ to $x+3$ $x+4$ " $x+8$	$x-2$ to $x+2$ $x+3$ " $x+7$	$x-3$ to $x+1$ $x+2$ " $x+6$	$x-4$ to x $x+1$ " $x+5$	Average Values
30	*.008288*	.008361	.008300	.008205	.008364	.008304
31	.008639	*.008443*	.008557	.008508	.008537	.008538
32	.008872	.008943	*.008640*	.008803	.008759	.008805
33	.009016	.009235	.009240	*.008897*	.009082	.009091
34	.009362	.009298	.009556	.009479	*.009200*	.009377
35	*.009510*	.009670	.009590	.009764	.009669	.009642
36	.009864	*.009840*	.009940	.009860	.009901	.009882
37	.010065	.010064	*.010143*	.010170	.010098	.010109
38	.010347	.010215	.010278	*.010403*	.010362	.010319
39	.010573	.010604	.010424	.010549	*.010640*	.010558
40	*.010903*	.010824	.010860	.010739	.010893	.010841

It will be noticed that Professor Glover used all five of the separate formulae, the figures corresponding to those derived by him being printed in italics in Tables I, J and K. In a few places slight differences may be noted between the figures given above and Professor Glover's figures. These are probably due to dropping decimals in the method used by Professor Glover in obtaining his figures.

The values in Table K may be rearranged so that the values derived from grouping ages 30–34, 35–39, etc., are in one column and other groupings in the other columns. By this table a comparison of the application of the method used by Professor Glover to the different age groupings can be made more readily. It may be well to bear in mind that no matter what grouping is used, the totals of the graduated and ungraduated values will agree within the five age groups. The values of q_x are rearranged in Table L.

TABLE L—VALUES OF q_x.

x	0–4 5–9	1–5 6–0	2–6 7–1	3–7 8–2	4–8 9–3	Average Values
30	.008288	.008364	.008205	.008300	.008361	.008304
31	.008443	.008639	.008537	.008508	.008557	.008538
32	.008640	.008943	.008872	.008759	.008803	.008805
33	.008897	.009240	.009235	.009016	.009082	.009091
34	.009200	.009479	.009556	.009298	.009362	.009377
35	.009510	.009669	.009764	.009590	.009670	.009642
36	.009840	.009864	.009901	.009860	.009940	.009882
37	.010143	.010064	.010065	.010098	.010170	.010109
38	.010403	.010278	.010215	.010347	.010362	.010319
39	.010640	.010549	.010424	.010604	.010573	.010558
40	.010903	.010893	.010739	.010860	.010824	.010841

As a test of the smoothness of the graduated values, the third differences are shown in Table M, but carried to one more decimal place than in Table X of Professor Glover's article.

TABLE M—VALUES OF $10^3\Delta^3 q_x$.

x	0–4 5–9	1–5 6–0	2–6 7–1	3–7 8–2	4–8 9–3	Average Values
30	+18	−36	+25	−37	−17	−14
31	−14	−51	−70	+19	−32	−19
32	−39	+ 9	−71	−15	+27	−21
33	+13	+54	+42	−32	−66	− 4
34	−47	0	+98	−10	− 2	+12
35	−16	+ 9	−41	+43	+ 2	− 4
36	+20	+43	+73	− 3	+57	+46
37	+49	+16	+47	− 9	+21	+15
Totals*	216	218	467	168	224	135

* Irrespective of sign.

As might be expected, the sum of the third differences irrespective of sign is smallest for the powerful twenty-nine term Osculatory Interpolation formula, but of the five short formulae the smallest sum is for the grouping where the quinquennial ages ending in 0 and 5 are the center of the groups. With a sufficient amount of data to allow full play for the operation of the law of averages, we would expect very little unevenness in the values of q_x between ages 30 and 40, were

it not for the misstatement of ages. The tendency to give an age ending in 0 or 5 is very strongly shown in the data to be graduated, and it seems not unreasonable to suppose that the graduation which will most satisfactorily remove this error will be the one showing the smoothest graduated values; provided, however, that the graduation formula does not remove any characteristics of the data, not due to error, which should be retained. So far as the limited test shows, the grouping of the ages with those ending in 0 and 5 as the center of the groups would seem to be more satisfactory than the groupings used by Professor Glover. In the first case the errors are spread over the younger as well as the older ages, while Professor Glover's grouping throws the errors entirely over the older ages of each quinquennial group.

In Table N are shown one million times the differences between the values of q_x by the twenty-nine term formula and by the shorter formulae. The positive and negative differences are added and the net differences and total differences irrespective of sign are shown at the foot of the table.

TABLE N.

ONE MILLION TIMES DIFFERENCES IN VALUES OF q_x BY TWENTY-NINE TERM AND SHORTER FORMULAE.

x	0–4 5–9	1–5 6–0	2–6 7–1	3–7 8–2	4–8 9–3
30	− 16	+ 60	− 99	− 4	+57
31	− 95	+101	− 1	−30	+19
32	−165	+138	+ 67	−46	− 2
33	−194	+149	+144	−75	− 9
34	−177	+102	+179	−79	−15
35	−132	+ 27	+122	−52	+28
36	− 42	− 18	+ 19	−22	+58
37	+ 34	− 45	− 44	−11	+61
38	+ 84	− 41	−104	+28	+43
39	+ 82	− 9	−134	+46	+15
40	+ 62	+ 52	−102	+19	−17
Positive	262	629	531	93	281
Negative	821	113	484	319	43
Net	−559	+516	+ 47	−226	+238
Total*	1083	742	1015	412	324

* Irrespective of sign.

Table N shows that the grouping used by Professor Glover produces values further from those given by the twenty-nine term formula than any of the other groupings, whether measured by the net difference of the eleven values or by the sum of the differences irrespective of sign. While the grouping 2 to 6, 7 to 1 gives the closest agreement in the aggregate, the individual differences are large. The next in order is the grouping having central ages ending in 0 or 5, and in this case the differences are not large. The grouping 4 to 8, 9 to 3 gives nearly as good results according to Table N, but Table M shows that the graduated values of q_x do not run as smoothly as with groupings 8 to 2, 3 to 7, where the central ages end in 0 or 5.

In conclusion it may be said that in using Professor Glover's plan of graduation the groupings to be used should be carefully considered. It is recognized that the foregoing study takes into account only eleven ages, but they are important ages and were chosen for the reason that marked changes in the progression of the rate of mortality are not looked for between ages 30 and 40. This paper is submitted with the thought that the points herein raised, if of value, may be borne in mind when the time comes to graduate the next Census Table.

A GENEALOGICAL STUDY OF POPULATION.

By Carl E. Jones.

The study of the many phases of the population problem has been a product in large part of the nineteenth and twentieth centuries, the period which has seen the rise and development of so many of the various fields of knowledge and of investigation closely related to the welfare and interests of mankind. Attention was prominently called to the subject at a time when the writings of the English Classical School of Political Economy were coming into the foreground. The doctrines of the decreasing returns upon land, of the increasing pressure of population upon the material means of subsistence resulted in a certain pessimism in the popular thought of that day which was well expressed in the name, "The Dismal Science," given to Political Economy.

The great interest in the topics of a biological nature which arose one or two generations later has done much to modify the positions held by the earlier writers and to strengthen the basis upon which further work might be done. Still more recently various aspects of the problem have been dealt with by biologists, sociologists, and economists, and the results of their respective findings hold much of promise for the future.

The mode of approach in the study of population problems has resembled that used in other branches of the social sciences in that it has gradually shifted from the philosophical and speculative to the mathematical and explanatory. Malthus in his "An Essay on the Principle of Population" (11) and Spencer in part six of his "Principles of Biology" (15), give classic illustrations of the manner of attack which was employed by the first students of the problem. Crum (2) (3), Duncan (4), Hill (7), Lewis (9), and Mayo-Smith (12), have been more recent students of the problem who have employed statistical data as the main tool in their treatment of such factors as natality, fecundity, marriage ages, and duration of life.

The sources of statistical information regarding population

in the United States most largely utilized hitherto, have been the national and state census figures. At the present time no other source is so copious and trustworthy but they do not afford an adequate basis for comparison of the present with other periods only slightly remote. Hence recourse must be had to whatever subsidiary material may be available for the purposes of comparing the population figures of the past one, two, or three centuries with those of the more immediate present.

For the purposes of comparisons for various periods of time, family genealogies furnish one of the most fertile fields of investigation. Since many American genealogies embrace the early settlers from whom many trace one line of their descent; a goodly number of them afford comparable data for two hundred to two hundred and fifty years. Ample time is thus afforded for the rise and fall and the cyclical development of such phenomena as fecundity and longevity to declare themselves.

The work of supplementing the results of national and state censuses by the data obtainable from genealogies is at present in its infancy. Bell has furnished some of the best results yet attained in this field. His recent publication, "The Duration of Life and Conditions Associated with Longevity—A Study of the Hyde Genealogy" (1) has given direct statistical proof for or against positions which formerly were dogmatically maintained, such as the inheritance of longevity, and the correlation between longevity and fertility. Sage has a recent work entitled "A Statistical Study of the Genealogical Records of New England" (14). One hundred genealogical lines, each covering the period 1620–1850, were studied. The data collected included dates of birth, deaths, and marriages of parents; details of second and third marriages; number and sex of children, dates and order of their birth, and dates of their death. Since the study traced the families only through the tail-male lines instead of through the whole family fraternity no basis was afforded for ascertaining the figures for important allied phenomena such as the inheritance of fecundity, the intervals between births, and the comparison of the fertility of the first-born children with the corresponding natality of the total population.

The aim of the present study is to obtain definite statistical data upon certain population characteristics; namely those relating to second, third, and fourth marriages; longevity; the correlation between longevity and fertility; the age at marriage; the correlation between marriage age and fertility; the fertility of parents by periods; the ratio of the sexes at birth; the intervals between births; twinning; and the fertility of first-born children. Each of these factors has been dealt with in turn and tables for each made which present the actual results obtained.

In explaining the method employed in attaining the completed tables, the sources or materials used will be described first and the process whereby the finished tabular results were obtained will then be outlined. Five genealogies were employed and complete indexing for each population trait studied was made of each individual within the family fraternities thus chosen. Each genealogy furnished approximately 4,000 individuals, and the five together furnished a total of 20,412 individuals. Incomplete returns for many individuals within each of the genealogies reduced the number of individuals used as a basis for each of the tables and hence in no case was a number as large as 20,000 obtained in the final tables.

The first step actually taken in the work was to obtain the figures for each one of the thousands of individuals for every one of the population traits to be treated. This process necessitated giving the most careful attention to each one of the household families listed in the several genealogies, since these were the units which afforded the bulk of the information regarding all of the topics under consideration.

The 20,412 individuals were distributed throughout approximately 4,000 such household families, each of the genealogies holding about 800 of this total figure. The compilation was next undertaken in order to get the mass of figures into significant totals and averages; and finally formal tabulation was necessary to present the material in clear and summary fashion. In the presentation of the results the findings for the five genealogies were lumped in the majority of cases since no significant differences were to be found in them. In such cases as twinning, however, where there were important differences,

the material was tabulated by the genealogies as well as by the total figures.

In the 20,412 individuals listed were comprised all those persons born in the five genealogies and also the husbands and wives who married into these families throughout all of the successive generations. Approximately 16,412 individuals were born in the main lines of descent, while the remaining 4,000 married into the families. Ten successive generations contained all of the individuals within each one of the five genealogies. The distribution of the 20,412 persons among the ten generations may be approximately stated as follows: 12, 35, 65, 200, 600, 1,700, 4,800, 7,000, 5,000, and 1,000. The fall in the numbers of the ninth and tenth generations was due to the fact that the reproducing potentialities of the eighth and ninth generations had not yet had time to reach their maximum. What would otherwise have been a uniform rise in the distribution was thus vitiated by this condition, though some weight must be given to an undoubted decline in racial fertility.

In presenting the tabular results obtained, the subject of remarriage is the first to receive treatment. In the table which follows the years from 1651 to 1900 are divided into five fifty-year periods, in order to afford a basis for comparison of periods of equal length. The numbers of husbands having second, third, or fourth wives and the number of wives who remarried, who were born within each one of these fifty-year periods respectively, are tabulated.

TABLE I. REMARRIAGES.

Period	Second Marriages	
	Husbands	Wives
1651–1700	8	4
1701–1750	42	10
1751–1800	63	23
1801–1850	108	29
1851–1900	25	21
Total	246	87

Inspection of the figures discloses the fact that nearly three times as many men as women remarried. If third, fourth,

and fifth marriages are taken into account, the 246 men who remarried had a total of 272 extra wives and the 87 women who remarried had a total of 94 extra husbands. A ratio of nearly three to one is maintained with these figures also. The figures for the last period are incomplete since so many of the individuals born within the latter portion of it did not have time to attain a marriageable age at all and hence could afford no data for remarriages.

There are very few other treatises of a similar nature with which to compare these figures. Bell does not attack the problem in "The Duration of Life and the Conditions Associated with Longevity." Sage, in "A Statistical Study of the Genealogical Records of New England," found a relatively large proportion of second and third marriages prior to 1850.

The genealogies show that the cause of the remarriages has altered somewhat. Before 1840 the cases were nearly all due to premature death upon the part of either the husband or the wife, generally the latter, and the subsequent remarriage of the one remaining. Beginning about 1840 the genealogies show that divorce assumes an ever-increasing part as a condition associated with second and third marriages. This increase in divorce beginning in 1840, as shown by the genealogies, is in full harmony with the findings of those who have made careful studies of the problem, for instance Lichtenberger, in "Divorce: A Study in Social Causation" (10).

The data for the longevity or duration of life will next be given and by fifty-year periods. No figures will be given for the period 1851–1900, however, since the only individuals born in this period who had died previous to the writing of the genealogies were those dying at comparatively youthful ages. Accordingly the data will be restricted to the four fifty-year periods from 1651–1850. The results are tabulated here according to sex; according to the number of individuals in each chronological group; and the average age-lengths for each of these groups is shown. The incompleteness of these genealogies is well illustrated by the small number of persons, 2,765, out of some 13,000 to 14,000 who had died, for whom the actual length of life could be ascertained.

TABLE II. DURATION OF LIFE.

Period	Males		Females	
	Number	Average Age	Number	Average Age
1651–1700	60	44.1	56	46.8
1701–1750	188	53.9	189	51.4
1751–1800	428	49.2	427	47.5
1801–1850	709	35.8	708	35.7
Total	1,385	42.8	1,380	41.9

Table II shows a shorter longevity for both males and females for the last period than for any of the preceding, but this is probably due to the fact that the last period contained a much higher percentage of those dying in infancy. As between the sexes, each of the fifty-year periods, with the exception of the first, which includes only a small number of individuals, shows a slightly higher age at death for the males than for the females.

Sage reports an insufficient record of deaths in infancy also and discounts the value of his tables. He finds that the age of males at death is higher than that of females. Bell found the average age of 1,606 males to be 35.8 years and that of 1,352 females to be 33.4 years, a difference similar to that found in this study. His lower figures were due to the more inclusive figures upon child-mortality to be found in the Hyde genealogy. Over 35 per cent. of the total number of deaths included in Bell's study occurred before maturity was reached, whereas in the genealogies here dealt with, the record of the decease of children has been much less complete.

The correlation between longevity and fertility is next given for both fathers and mothers. In the ensuing table the ages of parental deaths are grouped into class-intervals of five years each; the figures for fathers and mothers are given separately; and under each sex are the figures showing the number of deaths for that sex dying within each class interval and the average number of children born to each at the time of death. The term, fertility, is used rather than fecundity: the former refers to the total number of children born while the latter has reference to the number of times child-birth takes place. The

occurrence of twins and triplets accounts for the difference between the numbers of the two phenomena.

TABLE III. LONGEVITY AND FERTILITY.

Ages at Death	Fathers		Mothers	
	Number of Deaths	Average Number of Children	Number of Deaths	Average Number of Children
18–22	0	0.0	1	0.0
23–27	3	0.7	6	1.7
28–32	5	2.6	9	2.5
33–37	15	3.7	13	4.4
38–42	27	4.1	21	5.0
43–47	23	5.1	26	5.0
48–52	19	5.0	23	5.2
53–57	34	6.7	26	5.8
58–62	35	6.6	27	5.4
63–67	48	5.4	39	6.0
68–72	49	5.1	44	6.2
73–77	52	6.9	34	5.8
78–82	54	6.1	44	6.2
83–87	43	6.2	24	6.9
88–92	20	7.5	21	8.0
93–97	11	7.6	7	7.6
98–102	3	9.0	1	7.0
103–107	1	10.0	1	5.0

This table shows that longevity and fertility are associated phenomena as regards both fathers and mothers. A longer period of reproductive capacity can not be the sole cause since fertility continues to increase in the age-groups after the powers of fecundity have ceased, especially in the case of the mothers.

Bell reached results which are nearly identical with these. He found that the number of children per marriage rose steadily as the age of the parents at death increased. Since he used class-intervals of twenty years rather than of five years he obtained figures which afforded a steady rise in the cases of both fathers and mothers.

In the table next given the distribution of the husbands and wives is given according to their age at marriage. In the first column are given the various marriage-age groups and in the other two columns are given the frequencies, or the number of husbands and wives marrying in each of these marriage age groups.

This table shows both the median average and the modal range of the marriage ages of the husbands to be higher than

TABLE IV. DISTRIBUTION OF AGES AT MARRIAGE.

Ages at Marriage	Husbands	Wives
13–17	2	99
18–22	303	732
23–27	691	461
28–32	282	120
33–37	91	37
38–42	40	14
43–47	15	7
48–52	9	1
53–57	3	0
58–62	4	1
63–67	1	0
68–72	1	0
Median Average	25.5	21.9

that of the wives. The commonly accepted belief that males marry at older ages than females is thus shown to be in agreement with the facts.

The following table shows the distribution of the husbands and wives born in the five fifty-year periods from 1651–1900 according to their average ages at first-marriage.

TABLE V. AVERAGE AGE AT FIRST-MARRIAGE BY PERIODS.

Period	Number of Marriages	Average Age of	
		Husbands	Wives
1651–1700	27	27.0	21.4
1701–1750	176	24.8	22.2
1751–1800	272	26.7	22.6
1801–1850	553	26.9	23.1
1851–1900	501	24.8	22.3
Total	1,529	25.8	22.6

Table V shows again that the age at marriage was higher for the husbands than for the wives. No clearly marked tendency for the ages to rise or to fall is to be noted from these results.

The correlation between the marriage ages of husbands and of wives at their first marriages and their fertilities will next be dealt with. In the first column of Table VI are given the various marriage ages and in the two succeeding columns the average number of children born to the husbands and wives married at each of these ages are given.

Clear evidence is given by these figures that there is a correlation between the age at marriage and fertility,—the lowest

TABLE VI. MARRIAGE AGES AND FERTILITY.

Marriage Ages	Average Number of Children for	
	Husbands	Wives
13–17	6.0	5.6
18–22	4.6	4.6
23–27	4.4	3.8
28–32	3.3	3.0
33–37	3.6	2.1
38–42	2.9	.9
43–47	2.7	.0
48–52	.8	.0
53–57	1.3	..
58 62	1.0	.0
63–67	1.0	..
68–72	.0	..

ages at marriage being associated with the greatest fertilities. This conclusion is of interest in connection with the problem of differential birth rates, since the portions of the population having the lowest ages at marriage possess the greatest child-bearing capacity to influence the composition of the next generation.

Next comes the fertility of parents by fifty-year periods. The children listed in each fifty-year period are those born within the period in question. The results are tabulated by fifty-year periods, the number of parental couples, the number of children born to them, and the average number which each parental couple gives birth to. The number of parental couples includes all of those grouped under any one period rather than the number giving birth to children. While the table is thus more correctly a measure of the fertility of the total number of married couples than of the fertilities of parents, the latter designation will be used, since those married couples with no children will be considered as having zero fertilities.

TABLE VII. FERTILITY OF PARENTS BY PERIODS.

Period	Number of Parental Couples	Number of Children	Children Per Married Couple
1651–1700	37	214	5.8
1701–1750	139	802	5.9
1751–1800	419	2,506	6.1
1801–1850	1,542	7,459	4.8
1851–1900	1,739	5,348	3.0
Total	3,876	16,329	4.2

The foregoing table shows a gradual rise in the fertility from 1650 until the close of the eighteenth century and a subsequent fall in the fertility during the course of the nineteenth century.

Table VIII shows the number of times of occurrence for each number of siblings from zero to twenty. Thus the table shows how many times there were zero children in the family, one child, two children, etc. The data are presented by the totals and subtotals for each fifty-year period also. The first column shows the number of children per family or the number of siblings, the next five columns contain the figures for the five fifty-year periods, and the final column gives the total number of occurrences for each number of siblings born.

TABLE VIII. OCCURRENCES OF SIBLINGS.

Number of Siblings	1651–1700	1701–1750	1751–1800	1801–1850	1851–1900	Total
0	4	5	33	64	116	222
1	0	7	17	137	358	519
2	3	7	39	206	373	628
3	0	14	25	203	300	542
4	2	12	40	210	217	481
5	7	20	36	140	135	338
6	5	12	38	150	79	284
7	4	17	45	110	69	245
8	6	14	37	109	41	207
9	3	11	32	67	28	141
10	2	10	27	58	14	111
11	1	7	23	41	7	79
12	0	0	10	26	1	37
13	0	2	10	16	0	28
14	0	0	2	3	1	6
15	0	1	3	2	0	6
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	1	0	0	1
20	0	0	1	0	0	1
Total	37	139	419	1,542	1,739	3,876
Average	5.8	5.9	6.1	4.8	3.0	4.2

Table VIII furnishes the data from which the percentages of the total number of families during each fifty-year period which had less than six children may be calculated. These figures for the five fifty-year periods from 1651 to 1900 were respectively .43, .48, .46, .62, and .86. A decrease in the percentage of families having over five children and an increase in the percentage of families having five or fewer children during each half of the nineteenth century is thus shown.

The modal figures for each fifty-year period may be obtained

from Table VIII. From 1651 until 1800 these figures ranged from four to eight inclusive; from 1801 until 1850 they ranged from two to six inclusive; and from 1851 until 1900 they ranged from one to three inclusive. The families with the largest number of children were found during the period from 1751 until 1800, with the periods upon either side running close behind. If it were possible to get genealogical data showing the number of siblings born to the families during the past twenty years, undoubtedly smaller figures would be obtained than for the preceding period.

The subject of the ratio of sexes at birth is the next to be considered. The results are tabulated by fifty-year periods, according to the number of males and the number of females born in each of the periods; and according to the number of males born during each period for each 1,000 females. The last column thus affords the basis for determining the ratio of the sexes at birth, or the intensity of masculinity.

TABLE IX. RATIO OF SEXES AT BIRTH.

Period	Number of Males	Number of Females	Males Per 1,000 Females
1651–1700	111	103	1,077
1701–1750	418	384	1,089
1751–1800	1,290	1,208	1,067
1801–1850	3,838	3,621	1,059
1851–1900	2,693	2,655	1,014
Total	8,350	7,971	1,047

Sage obtained figures radically different from the foregoing. He found the ratio from 1621 to 1850 to be 1,350 to 1,000, and 131 test families had a ratio of 1,180 to 1,000. As he suggests, the cause for these ratios was probably the failure to record many female children in the genealogies with which he worked. Lewis, in "Natality and Fecundity" (9), found that the masculinity of the births of Scotland of the year 1855 was 1,049, a figure differing but slightly from 1,047, our figure for the masculinity of the total births.

The intervals between births will next be dealt with. The subject has received increasing attention recently from students of population. Table X shows the average number of

years between births for each number of cases which afford the bases for these averages.

TABLE X. INTERVALS BETWEEN BIRTHS, BY NUMBER OF CHILDREN.

Number of Children	Number of Occurrences	Average Interval in Years
2	282	3.9
3	242	3.4
4	265	3.2
5	226	3.1
6	154	2.7
7	141	2.6
8	112	2.5
9	98	2.3
10	68	2.3
11	52	2.2
12	25	2.1
13	13	2.0
14	7	1.9
15	4	1.8
16	..	..
17	..	..
18	..	..
19	1	1.6
20	1	1.8

A steady and unbroken fall in the intervals between births is to be noted as the number of children in the family increases. As was to be expected, those families with the smallest number of children have the largest intervals between births and those families with the largest number of children have the shortest intervals between births. The high degree of correlation between the two conditions, as is shown by these figures, should be of interest to all concerned with the sizes of families and differential fertility rates among the various groupings of the total population.

Since the birth rate has fallen during the recent periods, and since the intervals between births increases as the fertility per family decreases, it is of interest to note to what extent the population as a whole shows evidence of a gradual lengthening of the intervals between births during the successive fifty-year periods. The following table presents figures which make for the validity of this disclosure. The data are tabulated by fifty-year periods, the number of cases which afford the bases for the averages, and the average intervals between births for each of the periods being set forth. The average for each period was found by obtaining the arithmetical mean for the average interval between births for each family having

fecundity within that period. The objection may be raised that this average gives a weighting of one to each family. However, a sufficiently large enough number of items have been taken in each case to make the results of this method of weighting nearly the same as those obtained by any other method of weighting.

TABLE XI. INTERVALS BETWEEN BIRTHS BY PERIODS.

Fifty-Year Periods	Number of Occurrences	Average Interval
1651–1700	34	2.47
1701–1750	111	2.52
1751–1800	215	2.57
1801–1850	667	3.34
1851–1900	567	3.41

From 1651 to 1800 the fertility of the population and the average interval between births both remained so nearly stationary as to afford no basis for drawing any conclusions. From 1801 to 1900 there was a marked decline in the rate of fertility, as is shown by Table VII, and an equally marked increase in the average interval between births emerges in Table XI. Adequate proof is thus given to the contention that correlative to the decline in fertility which took place during the nineteenth century there was also an increase in the average interval between births. The increase in the intervals between births might serve to lower the fertility from eight to six, or any other corresponding drop, but could not suffice to account for the whole range of the drop which actually took place.

The question of the intervals between births has a close intimacy with the welfare of the children actually born. Various writers have dealt with this problem. Guyer, in "Being Well Born" (6), page 166, says that too short an interval between childbirths would seem to be an infringement on the rights of the child as well as of the mother. Ewart, in "The Influence of Parental Age on Offspring" (5), page 211, writes that children born at intervals of less than two years after the birth of the previous child still show at the age of six a notable deficiency in height, weight, and intelligence, when compared with the children born after a

longer interval, or even with firstborn children. Ploetz, in "Neo-Malthusianism and Race Hygiene" (13), page 186, asserts that Neo-Malthusianism further affects the quality of the offspring by increasing the intervals between births. In families in which the parents intend to have only a few children, the mother is usually exempt from so frequent child-bearing and she has ample time for regaining her strength.

The subject of twinning is the next to demand discussion. Eighty-seven cases were recorded, fifty-five of which occasioned the birth of children of the same sex while thirty-two resulted in the birth of children of the opposite sexes. No information can be given as to the number of identical twins coming from the same oosperm and as to the number of twins coming from separate oosperms, since nothing but the identical dates of birth were afforded in any case to know of the fact of twinning. The distribution of these cases of twinning throughout the reproductive period of the mother were as follows: eighteen were firstbirths, thirteen occurred during the middle of the mother's reproductive period, and fifty-six occurred at the end of that. The large majority covered in the last figure, coupled with the fact that nearly all of the cases of twinning occurred in large families, affords support for the hypothesis that twinning is associated with a waning capacity of fecundity. The eighty-seven cases of twinning included three families each having two pairs of twins. In each of these cases the twins came at the end of a large family of children.

From the distribution of the cases of twinning among the five genealogies it would seem safe to draw the conclusion that twinning does run in families and may be inherited in some very definite manner. In the following table the number of individuals in each of the five genealogies is included and the number of cases of twinning in each is shown.

TABLE XII. DISTRIBUTION OF CASES OF TWINNING BY GENEALOGIES.

Genealogy Letter	Number of Individuals	Cases of Twinning
A	4,184	11
B	4,116	32
C	4,147	11
D	3,421	25
E	4,744	8

The table shows that, for the number of individuals included, two of the genealogies present about three times as many cases of twinning as do the other three genealogies. Bell says, in "The Duration of Life and the Conditions Associated with Longevity," chapter 1, that due to interbreeding the persons listed in any genealogy constitute a sample of the general population rather than a sample of a particular family in which family traits might be expected to make their appearance. It is readily granted that every genealogy contains an admixture of many different strains of the population due to constant intermarriage, but this does not seem to constitute an adequate reason for denying the inheritance of certain family traits through successive generations. Indeed, studies of polydactylism, syndactylism, web-footedness, chorea, feeblemindedness, and insanity show that these characteristics are inherited in families, and this despite the factor of constant intermarriage. Hence it is probably no less warrantable to conclude that twinning is a trait definitely inherited in certain strains of the population.

After his study of the Scottish population statistics for the year 1855, Duncan declared that fertility in twins of wives-mothers gradually increases up to a climax at the age of 35–39, remains high even after 40, and vanishes rapidly after the age of 44. The fertility in twins is inverse to the natality in general: the former increases and the latter decreases as the age of the wife-mother advances.

The problem of the firstborn children which is now to be dealt with receives a ray of illumination from the genealogies, since they afford a most satisfactory means for comparing the fecundity of the firstborns with that of the total population. The capacity to survive until maturity and to reproduce themselves is the measure thus taken as the basis of comparison. The genealogies afford no means of discovering directly the relative capacities of the individual firstborn children and of the other children. The measure of the capacity to reach adult age and to give birth to a population commensurate with their numbers does function, however, as a test of the general viability and vitality of the firstborns as compared with that of the total population. In Table XIII, the average

fertility of the total population stock included in the genealogies and of the firstborns is compared both for the fifty-year periods and for the entire period from 1651 to 1900.

TABLE XIII. FECUNDITY OF FIRSTBORN CHILDREN.

Period	Average Fertility of Total Stock	Average Fertility of Firstborns
1651–1700	5.8	6.4
1701–1750	5.9	5.8
1751–1800	6.1	5.7
1801–1850	4.8	4.9
1851–1900	3.0	2.8
Total	4.2	4.0

This table shows that the fertility of the firstborns who married was practically the same as the fertility of the total stock,—the slight difference between 4.2 and 4.0 being relatively small. The table is valueless, however, until a supplementary table is added which shows the relative percentages of the total population stock and of the firstborns who married and thus affords the basis for the table just given.

The following table gives the percentages of the total population stock and of the firstborns who married within each fifty-year period and within the whole period from 1651 to 1900.

TABLE XIV. PERCENTAGE OF POPULATION AND OF FIRSTBORNS MARRIED.

Period	Percent Married of Total Stock	Percent Married of Firstborns
1651–1700	.76	.77
1701–1750	.72	.71
1751–1800	.74	.73
1801–1850	.69	.69
1851–1900	.62	.60
Total	.69	.69

The foregoing table shows that the percentage of the total number of children born who married was the same as the percentage of the firstborn children who married. The results of the last two tables may now be combined. The first shows that the percentages of the total stock and of the firstborns who marry are the same, and the second shows that of those

who do marry the fertility of the firstborns and of the total stock are practically the same. Hence the conclusion is justified that in so far as the powers of fecundity and fertility are concerned, that the firstborn children are neither above nor below the average set by the total population stock. While the studies into other phases of the problem may show a handicapping of the firstborn children in some instances, or may fail to do so in others, the evidence given by these figures seems quite incontrovertible that in so far as the factor of fecundity is concerned, the firstborn children are neither aided nor retarded by their position of birth.

Table I–XIV may be summarized as follows: Remarriages occurred three times as often among the men as among the women. No conclusions of any validity could be drawn concerning the duration of life over the different periods since many cases of infant mortality were not recorded in the early periods. In this study as in those done by Bell and by Sage, the ages of the males at death as recorded are higher than the ages of the females. A high correlation is shown between longevity or duration of life and fertility for both fathers and mothers. The table giving the distribution of the ages at marriage of husbands and wives shows that the husbands married at later ages than did the wives. The table giving the average ages of husbands and wives at marriage by fifty-year periods affords no basis for drawing any conclusion concerning a rise or fall in the age at marriage. A high correlation appears between the marriage age and the fertility of both fathers and mothers. The fertility of parents is found to increase slightly during the years from 1651 to 1800 and to decrease noticeably during the years from 1801 to 1900. The modal number of children per family during the five fifty-year periods from 1651 to 1900 shows a decrease from four to eight from 1651 to 1800 down to two to six from 1801 to 1850 and to one to three from 1851 to 1900. The table showing the ratio of the sexes at birth shows an intensity of masculinity of 1,047 or a ration of 1,047 males to every 1,000 females. The average interval between births appears to decrease as the number of children in the family increases, and it is also shown that the average interval be-

tween births was from 30 to 40 per cent. greater dring the nineteenth century than it was during the eighteenth. The data about twinning show that the majority of cases occurred near the close of the reproductive period of the mother and that twinning probably ran in certain families. Finally, in dealing with the problem of the firstborn children it is shown that the fertility of the firstborns was neither above nor below that of the population strains which were dealt with taken as a whole.

As this summary would suggest, the aim of the whole work has been to obtain exact and concise information in regard to all of the subjects which have been under discussion. While the immediate purposes involved made it necessary that all interpretations become secondary and ancillary to the actual processes of compilation and tabulation, the more ultimate goal to be desired is that the resulting presentation may serve as supplementary source material to the censuses in obtaining statistical information in respect to the phenomena of population which have been under investigation.

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NOTICE TO MEMBERS.

By vote of the Board of Directors, the price of the publications of our Association will hereafter be $3.00 per annum; and the price per volume has been increased from $4.00 to $6.00. The Board has decided to allow single numbers to be sold at the usual price. This change is, of course, subject to ratification at the Annual Meeting of the Association, which no doubt will be obtained. It is proper, however, that subscribers should be given notice in advance.

THE EDITOR.

REVIEWS AND NOTES.

TWO LETTERS FROM G. H. KNIBBS, C.M.G., F.S.S., THE COMMONWEALTH STATISTICIAN OF AUSTRALIA.

(The following letters, which the Editor ventures to publish without having sought Mr. Knibbs' permission, are printed not so much for his complimentary remarks about the Memorial Volume but for his views on statistics, national as well as international. They are dated Melbourne, the 28th of June and the 23rd of July, 1918.)

"Your kind letter of 13th May has been in my hands for a little while, and today brought the History of Statistics, the memorial volume to commemorate the 75th anniversary of the American Statistical Association. It is a magnificent and very valuable volume and I am indeed glad to have a copy. I congratulate you most heartily upon its compilation and in view of the world's future it is obvious that a work of this kind was needed, and further, that the statistician will have to be the guide of governments as he was in the Statistisches Reichsamt in Berlin. I hope that legislating in the dark will be soon a thing of the past and that all nations worthy of the name will watch the trend of affairs in the light of the facts which a proper scheme of statistics would systematically record. . . .

"Facts brought to light during this great war have revealed the necessity of watching the food supply and the rate at which our industrial raw material is being exploited. I hope to lay the foundations of good practical systems of statistical methodology before I finish my statistical career, as I feel sure that the world will not be able to live in the future in the haphazard way it has in the past. Mankind is moving towards some great cataclysm or towards a higher evolution—one does not know which—but the deviltry of this war has shown that the human race must either recognize its solidarity or be prepared for conflicts compared with which the present war will be a mere circumstance."

"Since writing you on the 28th June I have had a little time to look into the very fine collection of papers preceded by your Presidential address of 13th February, 1914, on the History of the American Statistical Association. The whole idea is very happily conceived and it is interesting to notice that the Association has passed through its period of difficulty and has come out satisfactorily. There are some remarks in S. N. D. North's paper that are very much to the point. For example:—"The days of the laissez faire have gone forever. There is no longer any field of human activity into which it is not now accepted as both the right and the duty of the state to intervene, by investigation and remedial action."

"I am satisfied that every country which intends to be in the first rank of nations will have to make a thorough study of its affairs and guide the

development of its people both eugenically and economically. The old "go-as-you-please" system *must* disappear. Statistics used for the benefit of the people will replace the old use by monarchs of the Frederick the Great type. Really international statistics will, moreover, bring into relief the real questions for international settlement, viz., questions touching the standard of living, the rate of procreation, cosmopolitical economy, and all matters affecting the solidarity of the human race; for example, international services, the trade arrangements between nations, the regulations of productivity, the desirability or otherwise of the anonymity of capital.

"The thinkers of the world have not as yet resolutely faced these questions, nor have they faced the question whether we are to be under the guidance of the superior type of demagogue or under the guidance of the most capable and strenuous men of our day and generation, *i. e.*, under the guidance of the real aristocrats. You remember Carlyle's estimate of the mass of people. The political arena shews that appeals to passion and prejudice are more effectual than appeals to the higher elements of our being. Internationally, we appear still to be as dangerous as the shark tribes are to one another. The idea of international solidarity has been born but its light is very feeble. One can hardly say it is yet incarnate, but if we are to end the war we have a long way to go in the direction of the recognition of mutual rights. Fierce and ruthless struggle would mean a very bad time for the world for the instruments of destruction have become very terrible and must soon become still more so.

"Your idea was a very happy one and the matter in this commemorative volume will do much to bring about a popular realisation of the fact that the statistician and statistical method must be used not less in national affairs than it is in private business. The guidance of national development is of incalculable importance, and the present abominable war has shewn that we are not entitled to let matters drift. There is an immense field to be covered but there will be no difficulty in dealing with it if we endeavor to handle the whole problem systematically.

"Again warmly congratulating you,

"Believe me,

"Yours very sincerely,

"G. H. KNIBBS."

Census of Prairie Provinces, Population and Agriculture, 1916, Census and Statistics Office, Ministry of Trade and Commerce, Ottawa, J. de Labroquerie Taché, 1918.

An important contribution to American census material comes to hand in the complete edition of the 1916 population and agricultural census of the Canadian "Prairie Provinces," Manitoba, Saskatchewan, and Alberta. This census is one of a series of decennial censuses, 1906, 1916, etc. The information was apparently tabulated with most commendable promptness, since it was published early in 1917 in the form of three separate reports,

one for each province. Here we have an excellent illustration of the publication of information while it is still fresh and applicable to existing conditions. It is very gratifying to find an example so worthy of imitation appearing in war times, in the face of every difficulty, and with the opportunity for perfectly plausible excuses for delay.

In view of the present food situation, Part II, relating to Agriculture, will be studied with great interest by statesmen, economists, and statisticians. The value of the census is, of course, enhanced by the fact of its being one of a series. Such a table as that on page 300, showing the comparative yields of the principal field crops in 1905, 1910, and 1915, is invaluable as providing means for making estimates for years subsequent to 1915. For instance, it appears at a glance that the total production of the principal crops in the prairie provinces has more than tripled in ten years, a rate of increase very promising for the future.

But to draw a single salient fact from such a wealth of material is almost to misrepresent it; the uses of such a census are as numerous as the ends and purposes of those who use it. This census is clearly of very great potential utility to American statisticans, who may venture, herewith to express their respectful thanks to the Canadian Ministry of Trade and Commerce, and to the staff of the Office of the Census and Statistics.

Fourteen pages of summary tables and analysis, and about 280 pages of analytical tables are devoted to population. It is interesting to find significant items, such as religion, and housing, among the usual topics: age and sex distribution, conjugal condition, origin, language, and literacy. Twenty-two pages of analysis, based on 73 pages of detailed data, are given to agriculture. The statistics include: farm areas, field crops, fruits, animals animal products, and labor and wages.

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